



Design Basis Events Analysis

Mission

Ensure repository design and licensing requirements protect repository personnel, the public, and the environment

Benefits

- Safe receipt, handling, and disposal
- Repository design and license application which enables final disposition of all Department of Energy fuels
- Protection of personnel and the environment
- Effective risk management

Project Status

- Completed preliminary frequency and consequence analyses
- Grouped fuels to facilitate analyses
- Identified strategy that minimizes reliance on fuel-specific data and calculations
- Performing final frequency and consequence analyses to support license application

Purpose

The Nuclear Regulatory Commission requires the U.S. Department of Energy (DOE) to evaluate design basis events to ensure that people and the environment are adequately protected during repository preclosure operations. The National Spent Nuclear Fuel Program supports repository design basis events analysis by demonstrating that DOE-owned spent nuclear fuel does not adversely affect repository safety. Design basis events analysis is used in the national repository design and licensing and to establish administrative and operational controls to ensure safety during fuel receipt and handling.

Project Description

Hazard analysis has been performed to identify events that could potentially result in an unplanned release of radioactive material from DOE spent nuclear fuel. Probability trees have been developed to calculate the frequency of these events. Engineers identified the worst credible events (i.e., design basis events) and calculated potential consequences. Using these analyses, design requirements that prevent and mitigate the design basis events will be developed.



The energy absorbing skirt design of the standardized DOE spent nuclear fuel canister ensures containment even during an accidental drop event.

The DOE currently manages more than 250 spent nuclear fuel types. Engineers grouped these fuel types by design basis event characteristics to simplify the design basis events analysis. By segregating these fuel types into six groups which will respond similarly to design basis event conditions, this grouping minimized the required analyses, yet still thoroughly and defensibly bounded all potential radiological consequences from handling DOE fuel.

Benefits

An understanding of accident scenarios (including natural events) ensures repository safety through a repository design that adequately prevents and/or mitigates potential accidents. Understanding the potential accident scenarios also ensures safety is maintained through licensing requirements, operational constraints, and contingency planning that addresses those scenarios. The design



Events					Results		
Canister Drop	Canister Breach	Pyrophoric SWP Event	HEPA Failure	Significant Errors in Existing Radiocycle Data	Scenario #	Likelihood for 100-yr period	Expected Annual Dose (mrem)
				10X		The 10 CFR 63.111 requirements are exceeded at 10 ⁻⁴ for the 100 yr period.	The regulations allow category 2 data in the range of 1E-1 to 1E+3 mrem.
						Beyond Design Basis (i.e., Cat. 3):	
						4E-09 x 7E+05 =	2E-03
						3E-08 x 7.6E+06 =	2E-03
						1E-11 x 4E+04 =	4E-07
						9E-11 x 4E+03 =	4E-07
						2E-08 x 13 =	3E-07
						2E-07 x 1.0 =	2E-07
						Safety Case:	
						0.06 x No release =	0
						0.02 x No release =	0

Sample event sequence tree to establish the preclosure safety basis.

basis events analysis indicates that an unplanned radiological release from DOE spent nuclear fuel is not credible and that consequences are acceptable even if it were to occur.

Unique Capabilities

Design basis events analysis:

- Enables thorough and economical analysis by grouping fuels with similar characteristics
- Ensures that natural disasters and other credible accidents will not result in unsafe conditions
- Increases personnel safety and minimizes handling costs for DOE spent nuclear fuel by preparing design requirements that mitigate design basis events.

Project Status

Based on facility and canister design, analyses demonstrate that an unplanned radiological release from DOE spent nuclear fuel is not a credible event. Using conservative assumptions, consequence calculations demonstrate acceptability even during the extremely unlikely event of canister breach.

January 2001-April 2001
Complete event sequence probabilities

April 2001
Probability qualified

May 2001-January 2002
Complete the beyond design basis events consequence evaluation

June 2001-January 2002
Perform design basis events criticality calculations

Project Contacts

Henry Loo

Phone: (208) 526-3332
Fax: (208) 526-5337
Email: henry@inel.gov

Brett Carlsen

Phone: (208) 526-3347
Fax: (208) 526-5337
Email: bcarlsen@inel.gov